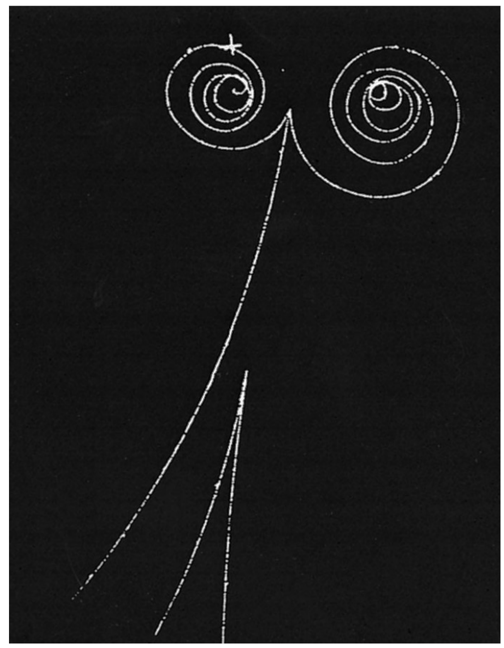
Starter

This image helps to illustrate our topic for today.

What might it show?

Where might it be from?



Sep 13-22:02

Current and charge	**Conservation of charge and Kirchoff's Laws**

Learning objectives	**MUST (C)**	Recall the principle of conservation of charge
	SHOULD (B)	Be able to state Kirchoff's first law, and recognise it as an application of charge conservation
	COULD (A/A*)	Apply Kirchoff's law to different circuits

We recall from our earlier lesson that charge is a fundamental physical quantity that must be conserved.

How did we define what 'charge' is?

A charged object experiences a force in an electromagnetic field

Can you think of another physical quantity that must be conserved?

Energy, momentum, angular momentum....

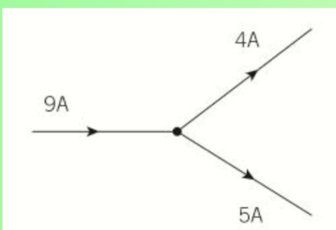
Can you explain what 'conservation' means?

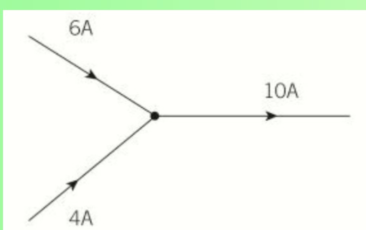
The charge in a closed system never changes

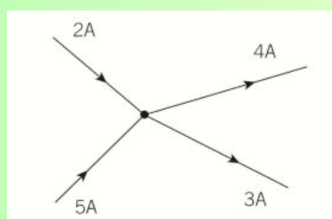
Current	**Kirchoff's First Law**
SHOULD (7)	Be able to state Kirchoff's first law, and recognise it as an application of charge conservation

Kirchoff's First Law states that:

'For any point in an electric circuit, the sum of currents into that point is the same as the sum of currents out of that point'







Can you explain why this is an application of conservation of charge?

Current	**Kirchoff's First Law**
COULD (8/9)	Apply Kirchoff's law to different circuits

Now work through questions 2-6 on page 130 of the textbook.

1 The total/net charge in any interaction must be the same before and after the interaction. [2]

[A simple, 'The charge in any interaction must be the same before and after the interaction' gains 1 mark]

2 As Figure 2 [1]

The sum of the current into a point must equal the sum of the current out of the point. [1]

3 **a** **i** 7 A towards the 2 A

ii 5 A away from the junction [both required for 1]

b **iii** 4 A towards the junction [1]

c **iv** 2 A to the left [1]

v 5 A to the left [1]

vi 7 A towards the junction [1]

4 Current in wire A =

$$I = \frac{1.9 \times 10^{21} \times 1.60 \times 10^{-19}}{60} = 5.06\ldots\text{ A} \quad [2]$$

Current in wire B = 15 A − 5.06... A = 9.9 A (2 s.f.) [1]

5 Discussion should include:

Charge must be conserved

Charge is due to electrons/ions

Therefore, the total number of electrons/ions must be conserved

Current is a flow of charge

Rate of flow of charge into a point must be equal to the rate of flow of charge from that point

[1 mark for each valid point, with up to three total marks]

6 Two protons have a net charge of $+2e$ (3.20×10^{-19} C) [1]

Any particles created in the collision must give rise to the same net charge. For example, if the positive charges are measured after the collision and found to be $+5e$, this suggests a particle (or several particles) with a charge of $-3e$ must have been created, ensuring the net charge remains at $+2e$. [1]

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Scientists are trying to create antimatter, but it is incredibly expensive. In 2008, CERN estimated that it had cost them several hundred million Swiss francs to make one billionth of a gram.

Why is it so difficult to keep antimatter - what happens to it?

Can you relate this to what we've learned today?

Extension: Can you explain why this doesn't violate conservation of mass?

Sep 10-23:12